RF TEST REPORT

SIEMIC
A Bureau Veritas Group Company

Report No.: FCC IC_RF_SL18010503-RUC-002_Zigbee Rev 1.0
Supersede Report No.: FCC IC_RF_SL18010503-RUC-002_Zigbee

Applicant	:	Ruckus Wireless, Inc.
Product Name	:	R730 Access Point
Model No.	:	R730
Test Standard	:	47 CFR 15.247 RSS 247 Iss 2: Feb 2017
Test Method	:	ANSI C63.10: 2013 RSS Gen Iss 4: Nov 2014 558074 D01 DTS Meas Guidance v04
FCC ID	:	S9GHR730
IC ID	:	5912A-R730
Dates of test	:	04/27/2018 to 06/20/2018
Issue Date	:	08/15/2018
Test Result	:	☒ Pass ☐ Fail
Equipment complied with the specification [X] Equipment did not comply with the specification [ ]		

This Test Report is Issued Under the Authority of:	
Cipher Chu	**Chen Ge**
Test Engineer	Engineer Reviewer

Issued By:
SIEMIC Laboratories
775 Montague Expressway, Milpitas, 95035 CA

ilac-MRA
ACCREDITED
TESTING CERT # 2742-01

Laboratory Introduction

SIEMIC, headquartered in the heart of Silicon Valley, with superior facilities in US and Asia, is one of the leading independent testing and certification facilities providing customers with one-stop shop services for Compliance Testing and Global Certifications.

In addition to testing and certification, SIEMIC provides initial design reviews and compliance management throughout a project. Our extensive experience with China, Asia Pacific, North America, European, and International compliance requirements, assures the fastest, most cost effective way to attain regulatory compliance for the global markets.

Accreditations for Conformity Assessment

Country/Region	Accreditation Body	Scope
USA	FCC, A2LA	EMC, RF/Wireless, Telecom
Canada	IC, A2LA, NIST	EMC, RF/Wireless, Telecom
Taiwan	BSMI, NCC, NIST	EMC, RF, Telecom, Safety
Hong Kong	OFTA, NIST	RF/Wireless, Telecom
Australia	NATA, NIST	EMC, RF, Telecom, Safety
Korea	KCC/RRA, NIST	EMI, EMS, RF, Telecom, Safety
Japan	VCCI, JATE, TELEC, RFT	EMI, RF/Wireless, Telecom
Mexico	NOM, COFETEL, Caniety	Safety, EMC, RF/Wireless, Telecom
Europe	A2LA, NIST	EMC, RF, Telecom, Safety
Israel	MOC, NIST	EMC, RF, Telecom, Safety

Accreditations for Product Certifications

Country	Accreditation Body	Scope
USA	FCC TCB, NIST	EMC, RF, Telecom
Canada	IC FCB, NIST	EMC, RF, Telecom
Singapore	iDA, NIST	EMC, RF, Telecom
EU	NB	EMC & R&TTE Directive
Japan	MIC (RCB 208)	RF, Telecom
Hong Kong	OFTA (US002)	RF, Telecom

CONTENTS

1 REPORT REVISION HISTORY 4
2 EXECUTIVE SUMMARY 5
3 CUSTOMER INFORMATION 5
4 TEST SITE INFORMATION 5
5 MODIFICATION 5
6 EUT INFORMATION 6
6.1 EUT Description 6
6.2 Radio Description 6
7 SUPPORTING EQUIPMENT/SOFTWARE AND CABLING DESCRIPTION 7
7.1 Supporting Equipment 7
7.2 Cabling Description 7
7.3 Test Software Description 7
8 TEST SUMMARY 8
9 MEASUREMENT UNCERTAINTY 9
9.1 Radiated Emissions (100kHz to 30MHz) 9
9.2 Radiated Emissions (30MHz to 1GHz) 9
9.3 Radiated Emissions (1GHz to 40GHz) 10
9.4 RF conducted measurement 10
10 MEASUREMENTS, EXAMINATION AND DERIVED RESULTS 11
10.1 Conducted Emissions 11
10.2 6dB & 99% Bandwidth 14
10.3 Output Power 18
10.4 Band Edge 22
10.5 Peak Spectral Density 24
10.6 Radiated Spurious Emissions below 1GHz 28
10.7 Radiated Spurious Emissions between 1GHz – 25GHz 30
ANNEX A. TEST INSTRUMENT 34
ANNEX B. SIEMIC ACCREDITATION 35

1 Report Revision History

Report No.	Report Version	Description	Issue Date
FCC IC_RF_SL18010503-RUC-002_Zigbee	None	Original	06/25/2018
FCC IC_RF_SL18010503-RUC-002_Zigbee Rev 1.0	1.0	Updated per customer	08/15/2018

2 Executive Summary

The purpose of this test program was to demonstrate compliance of following product

Company: Ruckus Wireless, Inc.
Product: R730 Access Point
Model: R730

against the current Stipulated Standards. The specified model product stated above has demonstrated compliance with the Stipulated Standard listed on 1st page.

3 Customer information

Applicant Name	:	Ruckus Wireless, Inc.
Applicant Address	:	350 West Java Drive, Sunnyvale, California 94089 U.S.A
Manufacturer Name	:	Ruckus Wireless, Inc.
Manufacturer Address	:	350 West Java Drive, Sunnyvale, California 94089 U.S.A

4 Test site information

Lab performing tests	SIEMIC Laboratories
Lab Address	775 Montague Expressway, Milpitas, CA 95035
FCC Test Site No.	881796
IC Test Site No.	4842D-2
VCCI Test Site No.	A0133

5 Modification

Index	Item	Description	Note
-	-	-	-

6 EUT Information

6.1 EUT Description

Product Name	R730 Access Point
Model No.	R730
Trade Name	Ruckus
Serial No.	111806000002
Host Model No.	N/A
Input Power	48VDC (PoE)
Power Adapter Manu/Model	N/A
Power Adapter SN	N/A
Date of EUT received	04/20/2018
Equipment Class/ Category	DTS, UNII
Port/Connectors	PoE, Ethernet

6.2 Radio Description

Spec for Zigbee:

Radio Type	Zigbee
Operating Frequency	2405MHz-2475MHz
Modulation	QPSK
Channel Spacing	5 MHz
Antenna Type	Integrated
Antenna Gain	0.55 dBi
Antenna Connector Type	N/A

7 Supporting Equipment/Software and cabling Description

7.1 Supporting Equipment

Item	Supporting Equipment Description	Model	Serial Number	Manufacturer	Note
1	Laptop	PP01L Latitude E5440	F1WPF12	Dell	-
2	POE Adapter	740-64211-001	133279963	Ruckus	-

7.2 Cabling Description

Name	Connection Start		Connection Stop		Length / shielding Info		Note
	From	I/O Port	To	I/O Port	Length (m)	Shielding	
RJ45	EUT	RJ45	POE	RJ45	2	Unshielded	-
RJ45	POE	RJ45	Laptop	RJ45	3	Unshielded	-

7.3 Test Software Description

Test Item	Software	Description
RF Testing	QCRT	Set the EUT to transmit continuously in diferent test modes and channels

8 Test Summary

Test Item	Test standard		Test Method/Procedure		Pass / Fail
Restricted Band of Operation	FCC	15.205	FCC	ANSI C63.10:2013 558074 D01 DTS Meas Guidance v04	☒ Pass ☐ N/A
	IC	RSS Gen 8.10	IC		
AC Conducted Emissions	FCC	15.207(a)	FCC	ANSI C63.10:2013	☒ Pass ☐ N/A
	IC	RSS Gen 8.8	IC	RSS Gen Issue 4: 2014	

DTS Band Requirement

Test Item	Test standard		Test Method/Procedure		Pass / Fail
99% Occupied Bandwidth	-	-	-	-	☒ Pass ☐ N/A
	IC	RSS Gen 6.6	IC	RSS Gen Issue 4: 2014 -	
6dB Bandwidth	FCC	15.247(a)(2)	FCC	558074 D01 DTS Meas Guidance v04	☒ Pass ☐ N/A
	IC	RSS247 (5.2.1)	IC		
Band Edge and Radiated Spurious Emissions	FCC	15.247(d)	FCC	ANSI C63.10:2013 558074 D01 DTS Meas Guidance v04	☒ Pass ☐ N/A
	IC	RSS247 (5.5)	IC		
Output Power	FCC	15.247(b)	FCC	558074 D01 DTS Meas Guidance v04	☒ Pass ☐ N/A
	IC	RSS247 (5.4.4)	IC		
Receiver Spurious Emissions	IC	RSS Gen (4.8)	IC	RSS Gen Issue 4: 2014	☐ Pass ☒ N/A
Antenna Gain > 6 dBi	FCC	15.247(e)	FCC	-	☐ Pass ☒ N/A
	IC	-	IC	-	
Power Spectral Density	FCC	15.247(e)	FCC	558074 D01 DTS Meas Guidance v04	☒ Pass ☐ N/A
	IC	RSS247 (5.2.2)	IC		
RF Exposure requirement	FCC	15.247(i)	FCC	-	☐ Pass ☒ N/A
	IC	RSS Gen(5.5)	IC	RSS Gen Issue 4: 2014	
Remark	1. All measurement uncertainties do not take into consideration for all presented test results.				

9 Measurement Uncertainty

9.1 Radiated Emissions (100kHz to 30MHz)

The test is to measure the radiated emissions of the EUT.

Some error sources that can contribute to the total uncertainty:
- Uncertainty of the receiver
- Uncertainty of the antenna
- Uncertainty of cables
- Uncertainty due to the mismatches

Source of Uncertainty	Value (dB)	Probability Distribution	Division	Sensitivity Coefficient	Expanded Uncertainty
Receiver Reading	0.10	Rectangular	1.732	1	0.069284
Cable Insertion Loss	0.21	Normal	2	1	0.105
Antenna Factor	0.65	Normal	2	1	0.325
Receiver CW accuracy	0.45	Rectangular	1.732	1	0.2598152
Mismatch	0.25	U-Shape	1.414	1	0.1768033
Combined Standard Uncertainty					0.935
Expanded Uncertainty (K=2)					**1.87**

The total derived measurement uncertainty is +/- 1.87 dB.

9.2 Radiated Emissions (30MHz to 1GHz)

The test is to measure the radiated emissions of the EUT.

Some error sources that can contribute to the total uncertainty:
- Uncertainty of the receiver
- Uncertainty of the antenna
- Uncertainty of cables
- Uncertainty due to the mismatches
- NSA Calibration
- Etc., details see the below table

Source of Uncertainty	Value (dB)	Probability Distribution	Division	Sensitivity Coefficient	Expanded Uncertainty
Receiver Reading	0.12	Rectangular	1.732	1	0.069284
Cable Insertion Loss	0.21	Normal	2	1	0.105
Filter Insertion Loss	0.25	Normal	2	1	0.125
Antenna Factor	0.65	Normal	2	1	0.325
Receiver CW accuracy	0.5	Rectangular	1.732	1	0.2886836
Pulse Amplitude Response	1.5	Rectangular	1.732	1	0.86605081
PRF Response	1.5	Rectangular	1.732	1	0.86605081
Mismatch Filter - Receiver	0.25	U-Shape	1.414	1	0.1768033
NSA Calibration	4.0	U-Shape	1.414	1	2.8288543
Combined Standard Uncertainty					3.0059131
Expanded Uncertainty (K=2)					**6.0118262**

The total derived measurement uncertainty is +/- 6.00 dB.

9.3 Radiated Emissions (1GHz to 40GHz)

The test is to measure the radiated emissions of the EUT.

Some error sources that can contribute to the total uncertainty:
- Uncertainty of the receiver
- Uncertainty of the antenna
- Uncertainty of cables
- Uncertainty due to the mismatches
- VSWR Calibration
- Etc., details see the below table

Source of Uncertainty	Value (dB)	Probability Distribution	Division	Sensitivity Coefficient	Expanded Uncertainty
Receiver Reading	0.12	Rectangular	1.732	1	0.0692840
Cable Insertion Loss	0.21	Normal	2	1	0.1050000
Filter Insertion Loss	0.25	Normal	2	1	0.1250000
Antenna Factor	0.65	Normal	2	1	0.3250000
Receiver CW accuracy	0.5	Rectangular	1.732	1	0.2886836
Pulse Amplitude Response	1.5	Rectangular	1.732	1	0.8660508
PRF Response	1.5	Rectangular	1.732	1	0.8660508
Mismatch Filter - Receiver	0.25	U-Shape	1.414	1	0.1768033
VSWR Calibration	2.0	U-Shape	1.414	1	1.4144272
Combined Standard Uncertainty					4.2363
Expanded Uncertainty (K=2)					**8.4726**

The total derived measurement uncertainty is +/- 8.47 dB.

9.4 RF conducted measurement

The test is to measure the RF output power from the EUT.

Some error sources that can contribute to the total uncertainty:

- Uncertainty of the Reference Level Uncertainty
- Uncertainty of variable attenuators
- Uncertainty of cables
- Uncertainty due to the mismatches

Source of Uncertainty	Value (dB)	Probability Distribution	Division	Sensitivity Coefficient	Expanded Uncertainty
Reference Level	0.12	Rectangular	1.732	1	0.069284
Cable Insertion Loss	0.21	Normal	2	1	0.105
Attenuator	0.25	Normal	2	1	0.125
Mismatch	0.25	U-Shape	1.414	1	0.1768033
Combined Standard Uncertainty					0.476087
Expanded Uncertainty (K=2)					**0.952174**

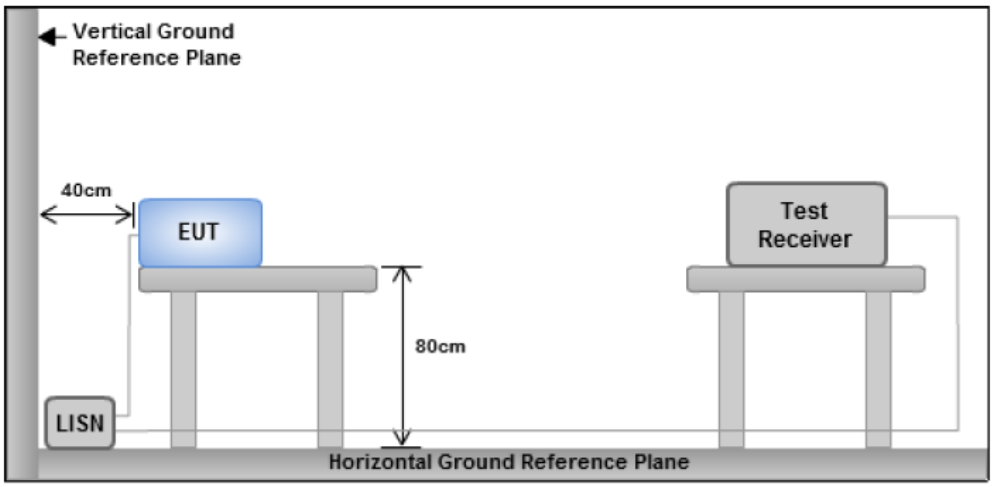
The total derived measurement uncertainty is +/- 0.95 dB.

10 Measurements, Examination and Derived Results

10.1 Conducted Emissions

Conducted Emission Limit

Frequency ranges (MHz)	Limit (dBuV)	
	QP	Average
0.15 ~ 0.5	66 – 56	56 – 46
0.5 ~ 5	56	46
5 ~ 30	60	50

Spec	Item	Requirement	Applicable
FCC 15.207 RSS-GEN Section 8.8	a)	For Low-power radio-frequency devices that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 µH/50 ohms line impedance stabilization network (LISN). The lower limit applies at the boundary between the frequency ranges.	☒
Test Setup	 Note: 1. Support units were connected to second LISN. 2. Both of LISNs (AMN) are 80 cm from EUT and at least 80 cm from other units and other metal planes	
Procedure	- The EUT and supporting equipment were set up in accordance with the requirements of the standard on top of a 1.5m x 1m x 0.8m high, non-metallic table, as shown in Annex B. - The power supply for the EUT was fed through a 50Ω/50µH EUT LISN, connected to filtered mains. - The RF OUT of the EUT LISN was connected to the EMI test receiver via a low-loss coaxial cable. - All other supporting equipment was powered separately from another main supply.	
Remark	EUT was tested at 120VAC, 60Hz	
Result	☒ Pass ☐ Fail	

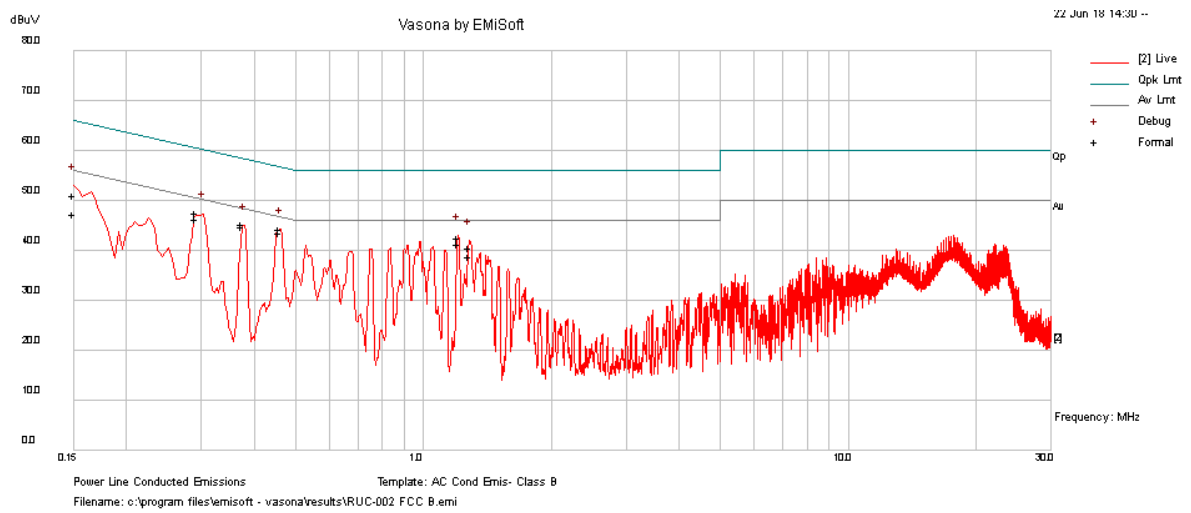
Test Data ☒ Yes ☐ N/A

Test Plot ☒ Yes (See below) ☐ N/A

Test was done by Cipher Chu at Conducted Emission test site.

Conducted Emission Test Results

Test specification:	Conducted Emissions			
Environmental Conditions:	Temp(°C):	21	Result:	☒ Pass ☐ Fail
	Humidity (%):	42		
	Atmospheric(mbar):	1021		
Mains Power:	120Vac, 60Hz			
Tested by:	Gary Chou			
Test Date:	06/22/2018			
Remarks	POE, Live			

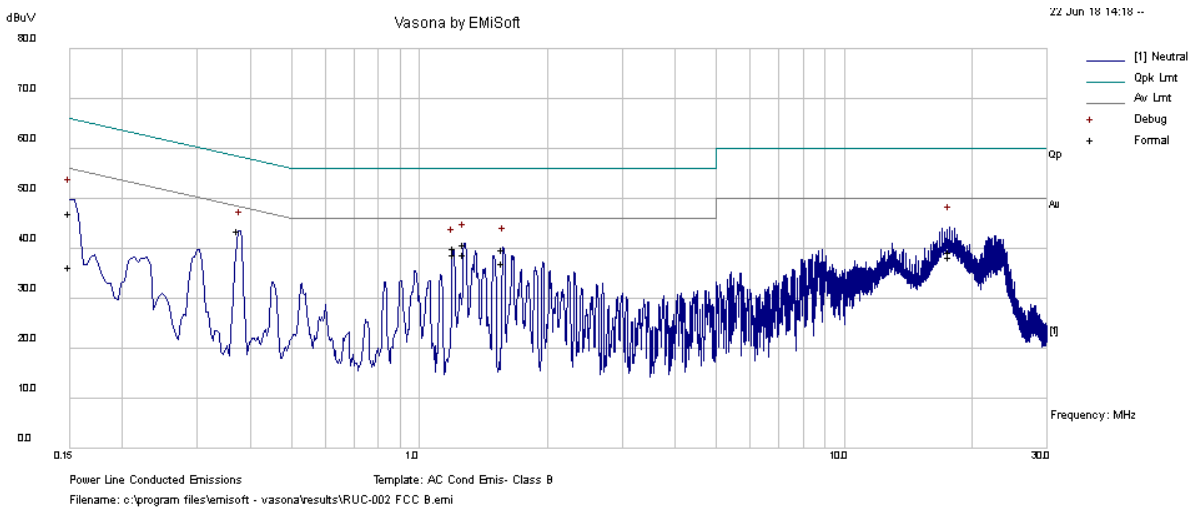


Live Plot at 120Vac, 60Hz

Frequency (MHz)	Raw (dBuV)	Cable Loss (dB)	Factors (dB)	Level (dBuV)	Measurement Type	Line / Neutral	Limit (dBuV)	Margin (dB)	Pass /Fail
0.46	34.99	9.33	0.04	44.36	Quasi Peak	Live	56.75	-12.39	Pass
0.29	38.19	9.32	0.04	47.56	Quasi Peak	Live	60.49	-12.93	Pass
0.15	41.7	9.33	0.05	51.08	Quasi Peak	Live	65.98	-14.9	Pass
1.20	33.32	9.33	0.05	42.7	Quasi Peak	Live	56	-13.3	Pass
0.37	35.91	9.33	0.04	45.28	Quasi Peak	Live	58.4	-13.12	Pass
1.28	31.09	9.34	0.05	40.47	Quasi Peak	Live	56	-15.53	Pass
0.46	34.29	9.33	0.04	43.66	Average	Live	46.75	-3.09	Pass
0.29	36.88	9.32	0.04	46.24	Average	Live	50.49	-4.25	Pass
0.15	38.03	9.33	0.05	47.41	Average	Live	55.98	-8.57	Pass
1.20	31.87	9.33	0.05	41.25	Average	Live	46	-4.75	Pass
0.37	35.57	9.33	0.04	44.93	Average	Live	48.4	-3.47	Pass
1.28	29.57	9.34	0.05	38.95	Average	Live	46	-7.05	Pass

Conducted Emission Test Results

Test specification:	Conducted Emissions			
Environmental Conditions:	Temp(°C):	21	Result:	☒ Pass ☐ Fail
	Humidity (%):	42		
	Atmospheric(mbar):	1021		
Mains Power:	120Vac, 60Hz			
Tested by:	Gary Chou			
Test Date:	06/22/2018			
Remarks	POE, Neutral			

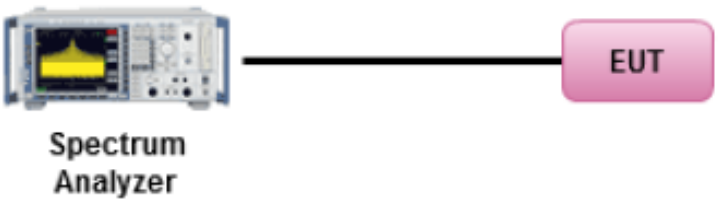


Neutral Plot at 120Vac, 60Hz

Frequency (MHz)	Raw (dBuV)	Cable Loss (dB)	Factors (dB)	Level (dBuV)	Measurement Type	Line / Neutral	Limit (dBuV)	Margin (dB)	Pass /Fail
0.37	34.17	9.33	0.04	43.53	Quasi Peak	Neutral	58.41	-14.88	Pass
1.28	31.46	9.33	0.05	40.85	Quasi Peak	Neutral	56	-15.15	Pass
17.72	29.4	9.43	0.42	39.25	Quasi Peak	Neutral	60	-20.75	Pass
1.57	30.39	9.34	0.06	39.79	Quasi Peak	Neutral	56	-16.21	Pass
1.20	30.6	9.33	0.05	39.99	Quasi Peak	Neutral	56	-16.01	Pass
0.15	37.7	9.33	0.05	47.08	Quasi Peak	Neutral	66	-18.92	Pass
0.37	34.13	9.33	0.04	43.5	Average	Neutral	48.41	-4.91	Pass
1.28	29.46	9.33	0.05	38.84	Average	Neutral	46	-7.16	Pass
17.72	28.45	9.43	0.42	38.3	Average	Neutral	50	-11.7	Pass
1.57	27.65	9.34	0.06	37.05	Average	Neutral	46	-8.95	Pass
1.20	29.54	9.33	0.05	38.92	Average	Neutral	46	-7.08	Pass
0.15	26.86	9.33	0.05	36.24	Average	Neutral	56	-19.76	Pass

10.2 6dB & 99% Bandwidth

Requirement(s):

Spec	Requirement	Applicable
§ 15.247 RSS247 (5.2.1)	6dB BW≥500KHz;	☒
RSS Gen 4.6.1	The transmitter shall be operated at its maximum carrier power measured under normal test conditions. The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts. The resolution bandwidth shall be set to as close to 1% of the selected span as is possible without being below 1%. The video bandwidth shall be set to 3 times the resolution bandwidth. Video averaging is not permitted. Where practical, a sampling detector shall be used given that a peak or peak hold may produce a wider bandwidth than actual. The trace data points are recovered and directly summed in linear terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached and that frequency recorded. The process is repeated for the highest frequency data points. This frequency is recorded. The span between the two recorded frequencies is the occupied bandwidth	☒
Test Setup		
Test Procedure	558074 D01 DTS Meas Guidance v04, 8.1 DTS bandwidth <u>6dB Emission bandwidth measurement procedure</u> - Set RBW = 100 kHz. - Set the video bandwidth (VBW) ⩾ 3 x RBW. - Detector = Peak. - Trace mode = max hold. - Sweep = auto couple. - Allow the trace to stabilize. - Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.	
Test Date	05/17/2018 – 06/20/2018	Environmental condition: Temperature 23ºC; Relative Humidity 42%; Atmospheric Pressure 1021mbar
Remark	N/A	
Result	☒ Pass ☐ Fail	

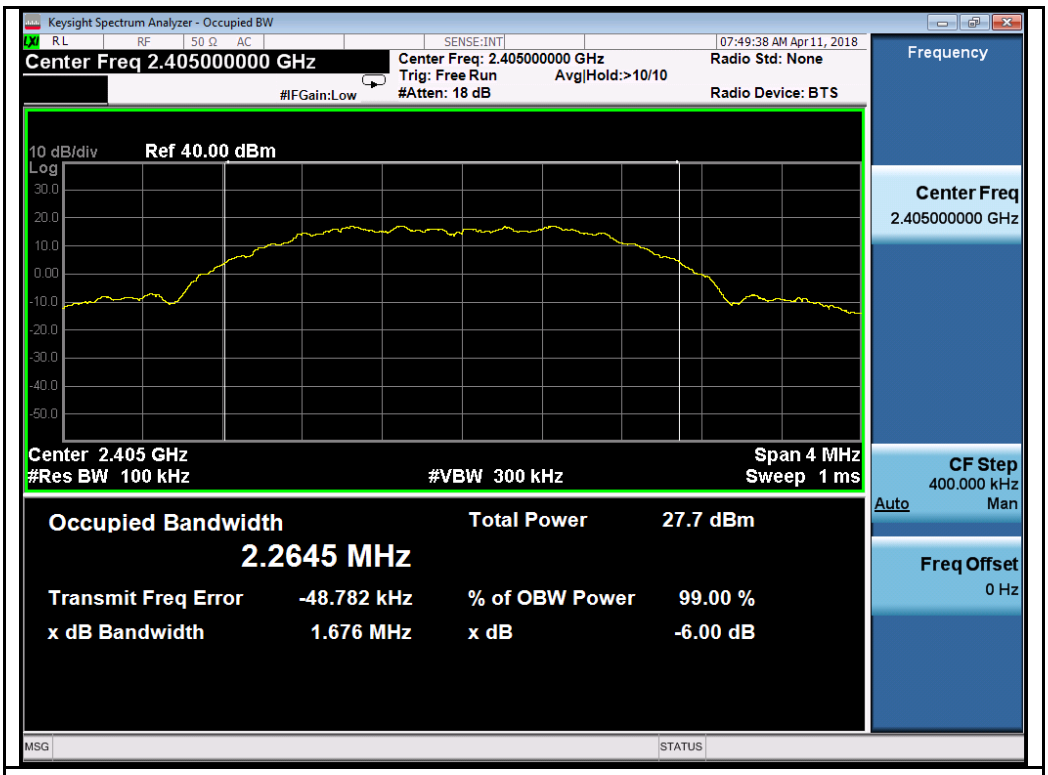
Test Data ☒ Yes ☐ N/A
Test Plot ☒ Yes ☐ N/A

Test was done by Chen Ge at RF test site.

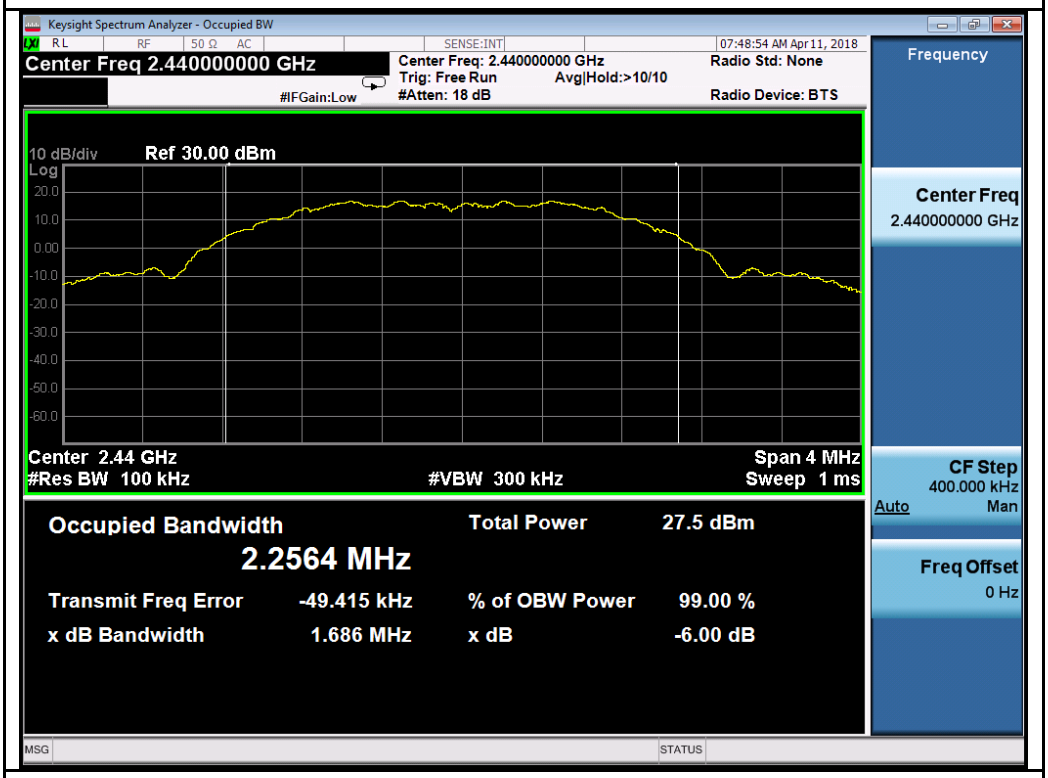
Zigbee:

Channel	Channel Frequency (MHz)	OBW	
		99% (MHz)	6dB(MHz)
Low	2405	2.26	1.67
Mid	2440	2.25	1.68
High	2480	2.26	1.64

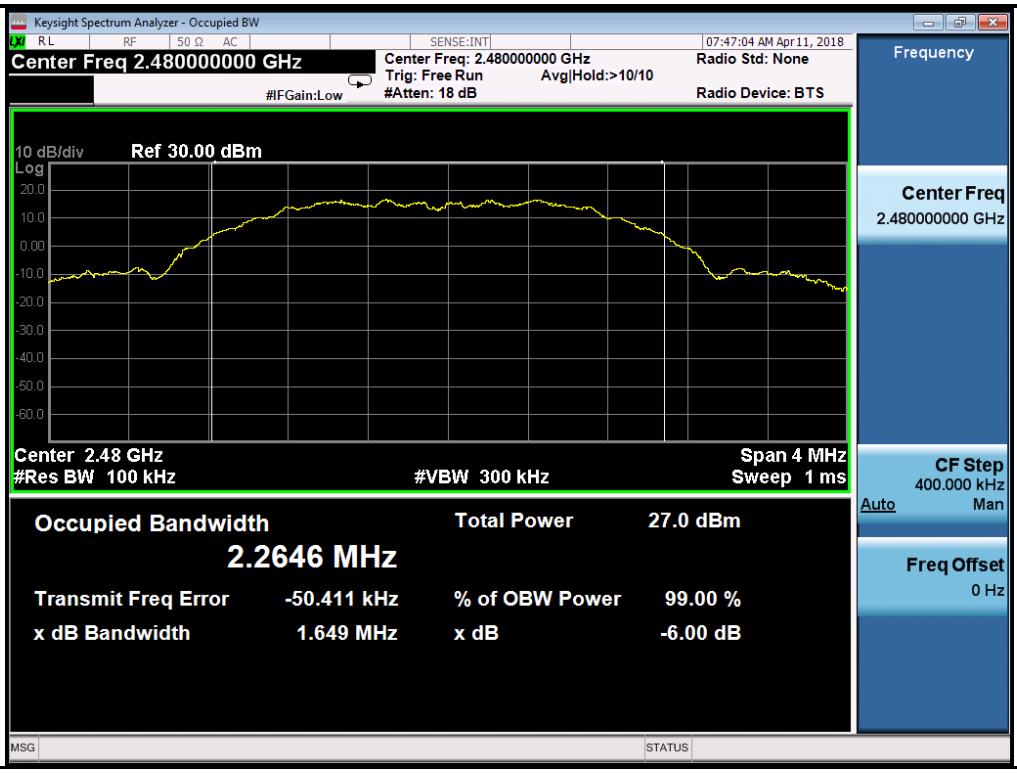
6dB & 99% Bandwidth Test Plots



Zigbee-2405MHz



Zigbee-2440MHz

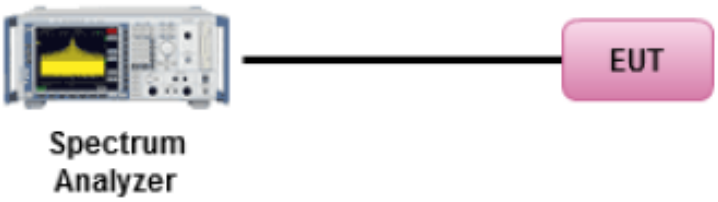


Zigbee-2480MHz

10.3 Output Power

Requirement(s):

Spec	Item	Requirement	Applicable
§ 15.247 RSS247 (5.4.4)	a)	FHSS in 2400-2483.5MHz with ≥ 75 channels: ≤1 Watt	☐
	b)	FHSS in 5725-5850MHz: ≤1 Watt	☐
	c)	For all other FHSS in the 2400-2483.5MHz band: ≤0.125 Watt.	☐
	d)	FHSS in 902-928MHz with ≥ 50 channels: ≤1 Watt	☐
	e)	FHSS in 902-928MHz with ≥ 25 & <50 channels: ≤0.25 Watt	☐
	f)	DSSS in 902-928MHz, 2400-2483.5MHz, 5725-5850MHz: ≤1 Watt	☒

Test Setup				
Test Procedure	558074 D01 DTS Meas Guidance v04, 9.1.1 Measurement using a Spectrum Analyzer (SA) This procedure shall be used when the measurement instrument has available a resolution bandwidth that is greater than the DTS bandwidth. (a) Set the RBW ≥ DTS bandwidth. (b) Set VBW ≥ 3 RBW. (c) Set span ≥ 3 RBW (d) Sweep time = auto couple. (e) Detector = peak. (f) Trace mode = max hold. (g) Allow trace to fully stabilize (h) Use peak marker function to determine the peak amplitude level.			
Test Date	05/17/2018 – 06/20/2018	Environmental condition	Temperature Relative Humidity Atmospheric Pressure	23°C 44% 1021mbar
Remark	NONE			
Result	☒ Pass ☐ Fail			

Test Data ☒ Yes ☐ N/A

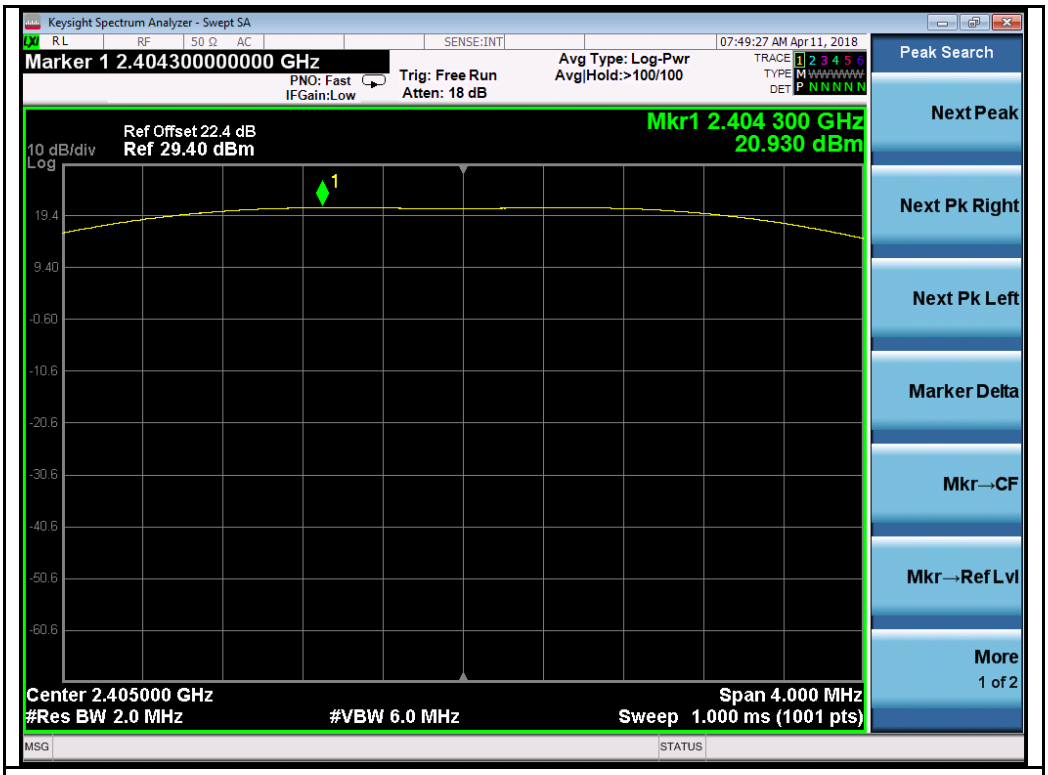
Test Plot ☒ Yes (See below) ☐ N/A

Test was done by Chen Ge at RF test site.

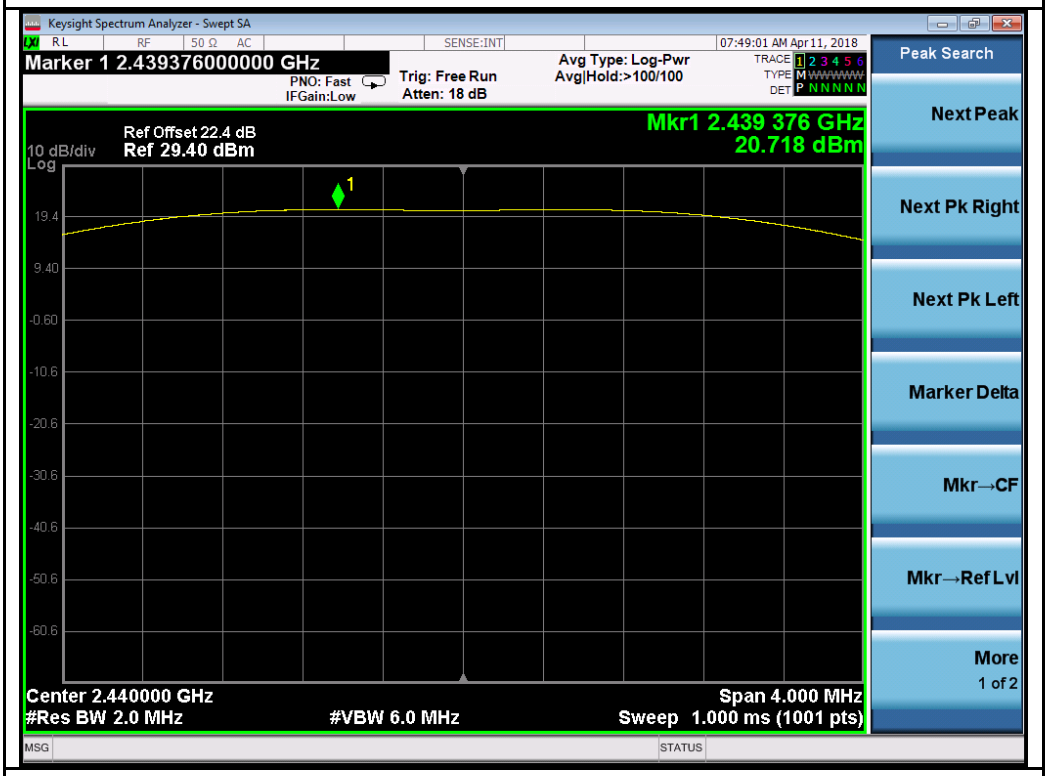
Output Power measurement results for Zigbee:

Type	Freq (MHz)	Test mode	CH	Conducted Power (dBm)	Limit (dBm)	Result
Output power	2405	Zigbee	Low	20.93	≤30	Pass
	2440	Zigbee	Mid	20.71	≤30	Pass
	2480	Zigbee	High	20.47	≤30	Pass

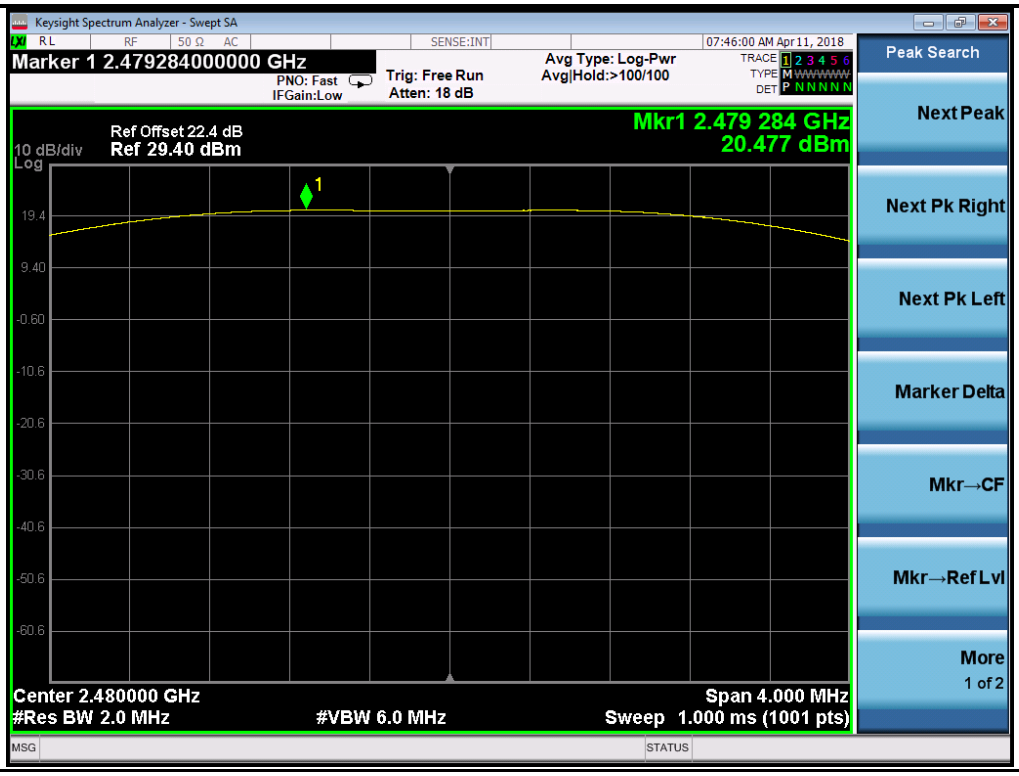
Test Plots:



Zigbee-2405MHz



Zigbee-2440MHz

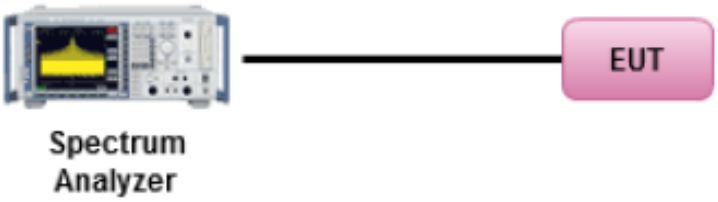


Zigbee-2480MHz

10.4 Band Edge

Requirement(s):

Spec	Item	Requirement	Applicable
§ 15.247 RSS247(5.5)	d)	For non-restricted band, In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB or 30dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, determined by the measurement method on output power to be used. Attenuation below the general limits specified in § 15.209 (a) is not required ☐ 20 dB down ☒ 30 dB down	☒

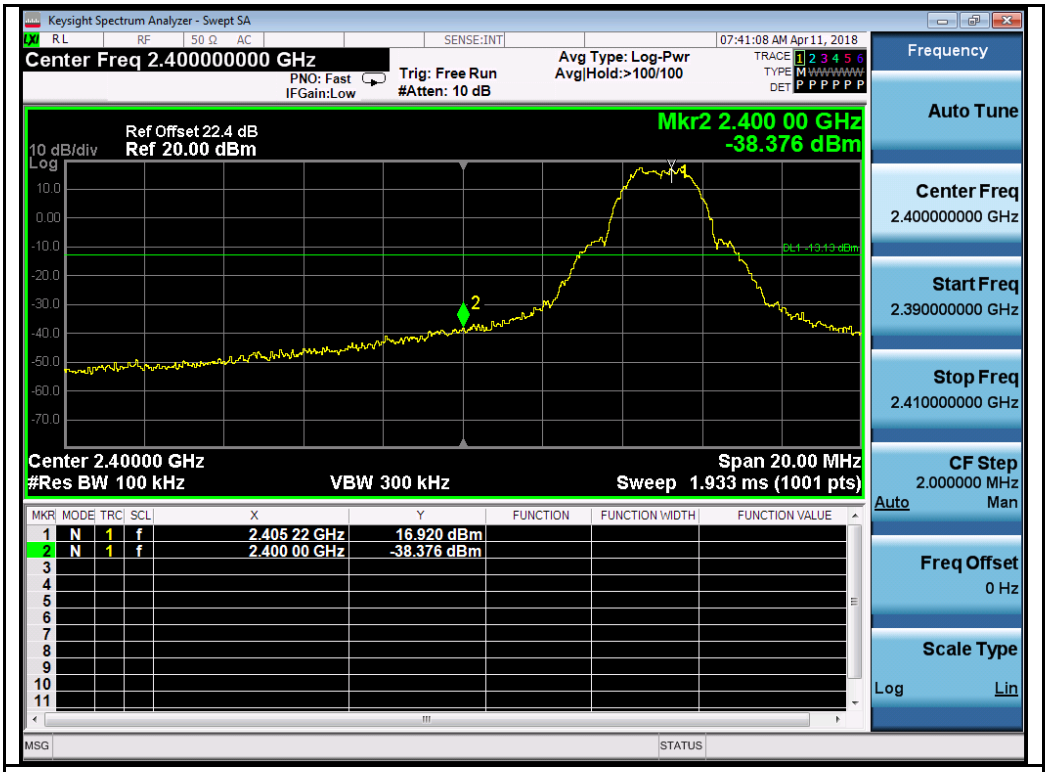
Test Setup			
Test Procedure	558074 D01 DTS Meas Guidance v04 Band Edge measurement procedure 1. Set the EUT to maximum power setting and enable the EUT transmit continuously. 2. Band edge emissions must be at least 30 dB down from the highest emission level within the authorized band as a measured. The attunation shall be be 30 dB instead of 20 dB when Peak conducted output power procedure is used. 3. Change modulation and channel bandwidth then repeat step 1 to 2. 4. Measured and record the results in the test report.		
Test Date	05/17/2018 – 06/20/2018	Environmental condition	Temperature 22°C Relative Humidity 46% Atmospheric Pressure 1020mbar
Remark	-		
Result	☒ Pass ☐ Fail		

Test Data ☐ Yes ☒ N/A

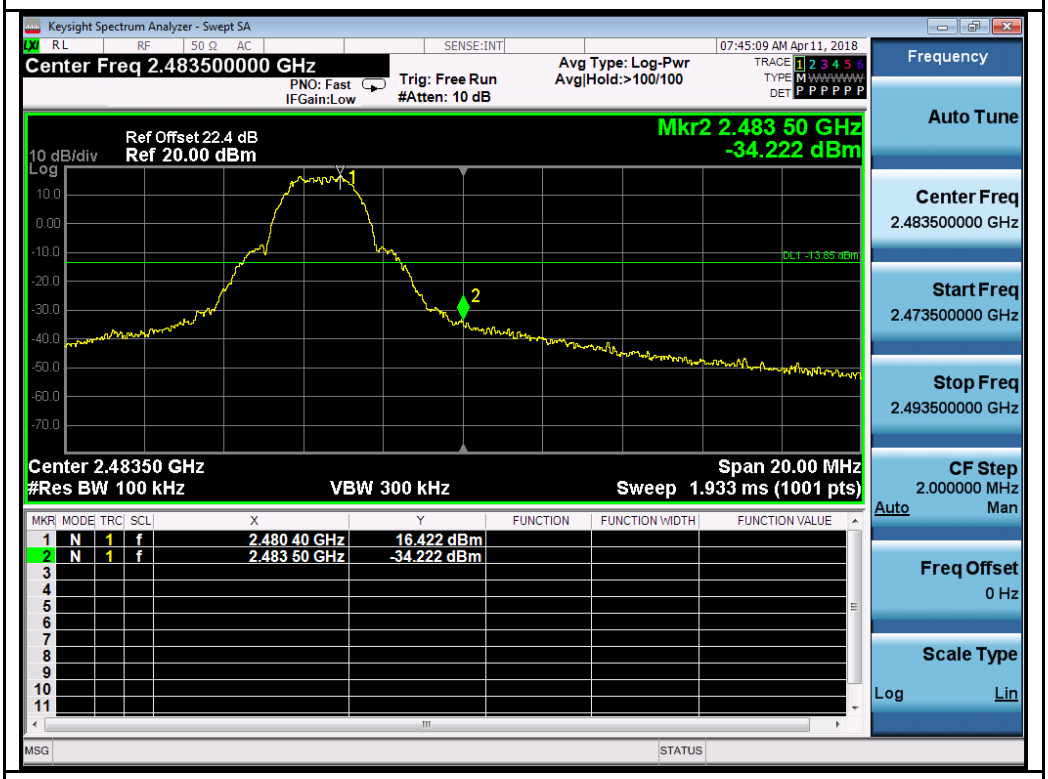
Test Plot ☒ Yes (See below) ☐ N/A

Test was done by Chen Ge at RF test site.

Test Plots:



Zigbee-2405MHz

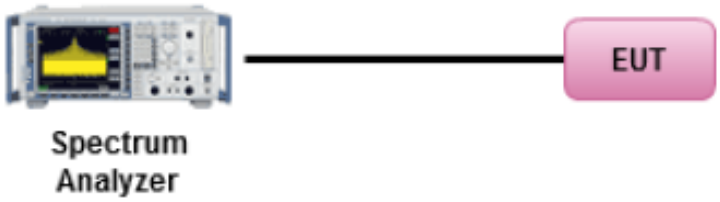


Zigbee-2480MHz

10.5 Peak Spectral Density

Requirement(s):

Spec	Item	Requirement	Applicable
§ 15.247(e) RSS247 (5.2.2)	e)	DSSS: ≤8dBm/3KHz	☒
	f)	DSSS in hybrid sys with FH turned off: ≤8dBm/3KHz	☐

Test Setup			
Test Procedure	558074 D01 DTS Meas Guidance v04, 10.2 Method PKPSD (peak PSD) Peak spectral density measurement procedure - Set analyzer center frequency to DTS channel center frequency. - Set the span to 1.5 times the DTS bandwidth. - Set the RBW to: 3 kHz ⩽ RBW ⩽ 100 kHz. - Set the VBW ⩾ 3 x RBW. - Detector = Peak - Sweep time = auto couple. - Trace mode = Max Hold - Allow trace to fully stabilize. - Use the peak marker function to determine the maximum amplitude level within the RBW. - If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.		
Test Date	05/17/2018 – 06/20/2018	Environmental condition	Temperature 22ºC Relative Humidity 46% Atmospheric Pressure 1020mbar
Remark	N/A		
Result	☒ Pass ☐ Fail		

Test Data ☒ Yes ☐ N/A

Test Plot ☒ Yes (See below) ☐ N/A

Test was done by Chen Ge at RF test site.

PSD measurement results for Zigbee:

Type	Freq (MHz)	Test mode	CH	Conducted PSD (dBm/3KHz)	Limit (dBm/3KHz)	Result
PSD	2405	Zigbee	Low	4.70	8	Pass
	2440	Zigbee	Mid	5.12	8	Pass
	2480	Zigbee	High	4.49	8	Pass

Test Plots

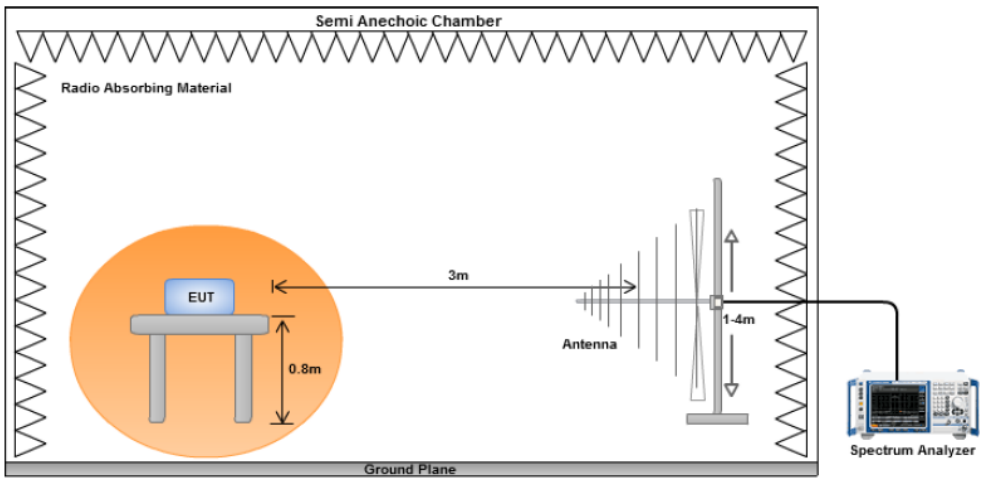
Zigbee-2405MHz

Zigbee-2440MHz

Zigbee-2480MHz

10.6 Radiated Spurious Emissions below 1GHz

Requirement(s):

<table>
<tr><th>Spec</th><th>Item</th><th>Requirement</th><th>Applicable</th></tr>
<tr><td>47CFR§15.247(d)
RSS247 (5.5)</td><td>a)</td><td>Except higher limit as specified elsewhere in other section, the emissions from the low-power radio-frequency devices shall not exceed the field strength levels specified in the following table and the level of any unwanted emissions shall not exceed the level of the fundamental emission. The tighter limit applies at the band edges
<table>
<tr><th>Frequency range (MHz)</th><th>Field Strength (uV/m)</th></tr>
<tr><td>30 – 88</td><td>100</td></tr>
<tr><td>88 – 216</td><td>150</td></tr>
<tr><td>216 960</td><td>200</td></tr>
<tr><td>Above 960</td><td>500</td></tr>
</table></td><td>☒</td></tr>
<tr><td>Test Setup</td><td colspan="3"> 
</td></tr>
<tr><td>Procedure</td><td colspan="3">1. The EUT was switched on and allowed to warm up to its normal operating condition.
2. The test was carried out at the selected frequency points obtained from the EUT characterisation. Maximization of the emissions, was carried out by rotating the EUT, changing the antenna polarization, and adjusting the antenna height in the following manner:
a. Vertical or horizontal polarisation (whichever gave the higher emission level over a full rotation of the EUT) was chosen.
b. The EUT was then rotated to the direction that gave the maximum emission.
c. Finally, the antenna height was adjusted to the height that gave the maximum emission.
3. A Quasi-peak measurement was then made for that frequency point.
4. Steps 2 and 3 were repeated for the next frequency point, until all selected frequency points were measured.</td></tr>
<tr><td>Remark</td><td colspan="3">The EUT was scanned up to 1GHz. Both horizontal and vertical polarities were investigated. The results show only the worst case. The EUT was evaluated in each of three orthogonal axis positions, the orientation is the worst case, please refer to setup photos.</td></tr>
<tr><td>Result</td><td colspan="3">☒ Pass ☐ Fail</td></tr>
</table>

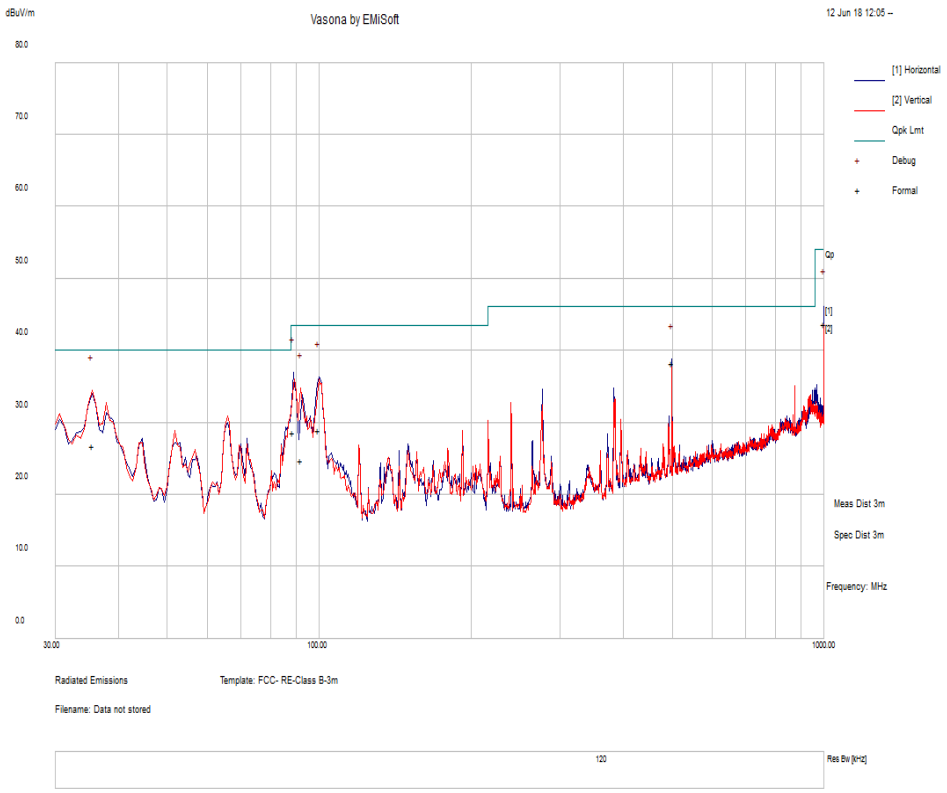
Test Data ☒ Yes (See below) ☐ N/A

Test Plot ☒ Yes (See below) ☐ N/A

Test was done by Chen Ge at 10m chamber.

Radiated Emission Test Results (Below 1GHz)

Test specification	below 1GHz			
Environmental Conditions:	Temp (°C):	26	Result	Pass
	Humidity (%)	47		
	Atmospheric (mbar):	1020		
Mains Power:	120VAC, 60Hz			
Tested by:	Gary Chou			
Test Date:	06/12/2018			
Remarks:	Zigbee, 2440MHz			

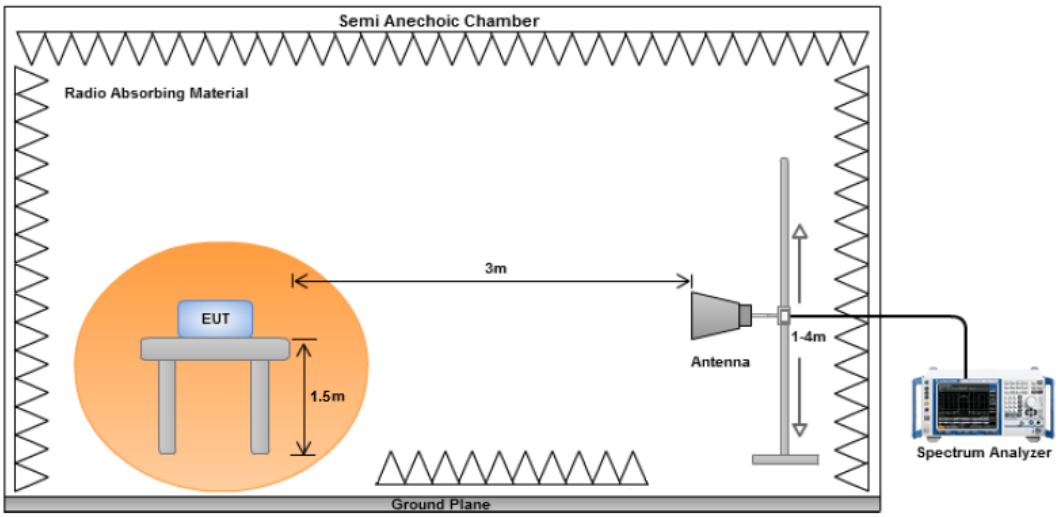


Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail
35.59	33.44	11.21	-17.87	26.79	Quasi Max	V	325	225	40	-13.21	Pass
88.86	44.7	11.78	-27.85	28.62	Quasi Max	H	247	127	43.5	-14.88	Pass
91.87	40.36	11.81	-27.34	24.83	Quasi Max	V	254	280	43.5	-18.67	Pass
99.54	42.64	11.88	-25.57	28.94	Quasi Max	H	146	248	43.5	-14.56	Pass
500.01	42.73	14.17	-18.55	38.35	Quasi Max	H	167	112	46	-7.65	Pass
1000.00	40.31	16.28	-12.92	43.67	Quasi Max	H	106	143	54	-10.33	Pass

Note: Both horizontal and vertical polarities were investigated. The results above show only the worst case.

10.7 Radiated Spurious Emissions between 1GHz – 25GHz

Requirement(s):

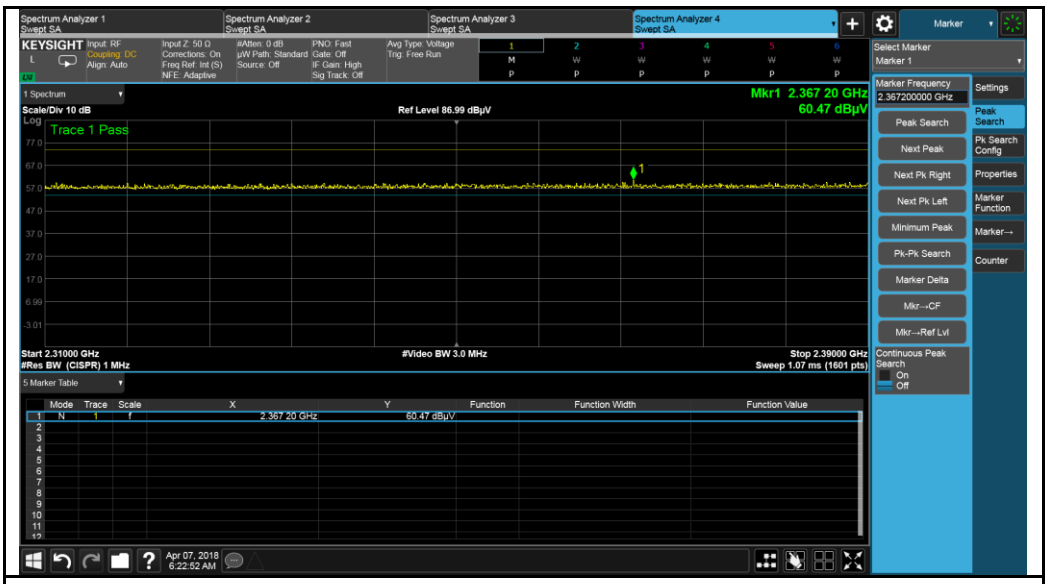
Spec	Item	Requirement	Applicable
47CFR§15.247(d), RSS247(A8.5)	a)	For non-restricted band, In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB or 30dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, determined by the measurement method on output power to be used. Attenuation below the general limits specified in § 15.209(a) is not required ☐ 20 dB down ☒ 30 dB down	☒
Test Setup			
Procedure	1. The EUT was switched on and allowed to warm up to its normal operating condition. 2. The test was carried out at the selected frequency points obtained from the EUT characterisation. Maximization of the emissions, was carried out by rotating the EUT, changing the antenna polarization, and adjusting the antenna height in the following manner: a. Vertical or horizontal polarisation (whichever gave the higher emission level over a full rotation of the EUT) was chosen. b. The EUT was then rotated to the direction that gave the maximum emission. c. Finally, the antenna height was adjusted to the height that gave the maximum emission. 3. An average measurement was then made for that frequency point. 4. Steps 2 and 3 were repeated for the next frequency point, until all selected frequency points were measured.		
Remark	The EUT was scanned up to 40GHz. Both horizontal and vertical polarities were investigated. The results show only the worst case. There isn't outstanding emission found at the edge of restricted frequency. The EUT was evaluated in each of three orthogonal axis positions, the orientation is the worst case, please refer to setup photos.		
Result	☒ Pass ☐ Fail		

Test Data ☒ Yes (See below) ☐ N/A

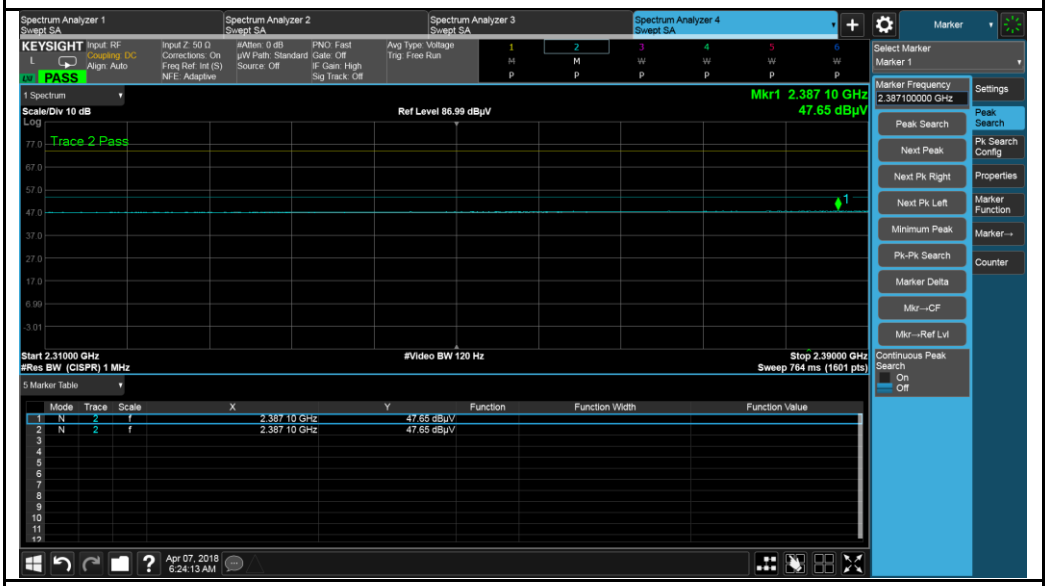
Test Plot ☐ Yes (See below) ☒ N/A

Test was done by Chen Ge at 10m chamber.

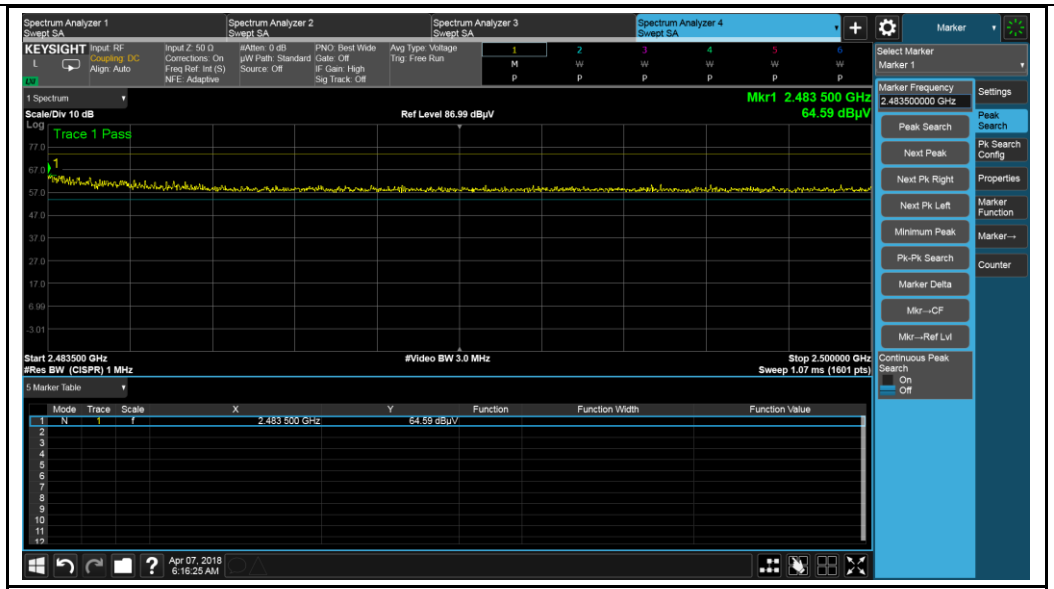
Restricted Band Measurement Plots:



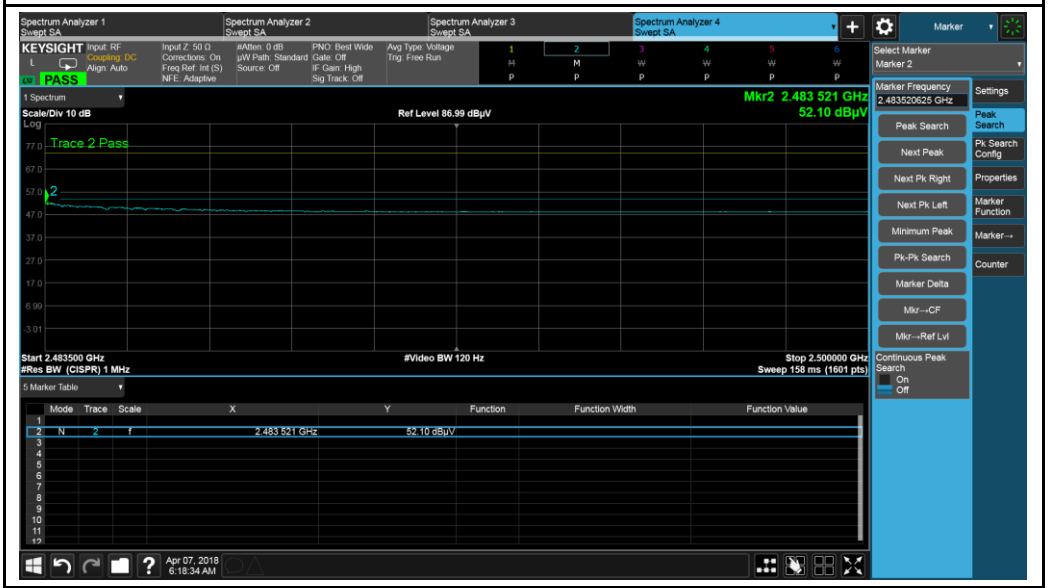
Zigbee-2405MHz Peak



Zigbee-2405MHz Average



Zige-2480MHz Peak



Zigbee-2480MHz Average

Radiated Emission Test Results (Above 1GHz)

Above 1GHz-25GHz- Zigbee - 2405MHz

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail
3814.88	50.12	3.64	-12.94	40.82	Peak Max	V	268	298	74	-33.18	Pass
4810.78	48.74	4.11	-10.91	41.94	Peak Max	V	230	41	74	-32.06	Pass
7701.70	42.52	5.2	-7.28	40.44	Peak Max	H	166	161	74	-33.56	Pass
3814.88	40.45	3.64	-12.94	31.15	Average Max	H	268	298	54	-22.85	Pass
4810.78	39.45	4.11	-10.91	32.65	Average Max	V	230	41	54	-21.35	Pass
7701.70	32.6	5.2	-7.28	30.52	Average Max	H	166	161	54	-23.48	Pass

Above 1GHz-25GHz- Zigbee - 2440MHz

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail
3007.58	49.71	3.28	-14.17	38.82	Peak Max	H	268	295	74	-35.18	Pass
4879.48	48.26	4.17	-11.03	41.4	Peak Max	V	228	43	74	-32.6	Pass
7967.91	42.4	5.4	-7.06	40.74	Peak Max	H	169	159	74	-33.26	Pass
3007.58	40.17	3.28	-14.17	29.28	Average Max	H	268	295	54	-24.72	Pass
4879.48	38.28	4.17	-11.03	31.42	Average Max	H	228	43	54	-22.58	Pass
7967.91	32.97	5.4	-7.06	31.31	Average Max	V	169	159	54	-22.69	Pass

Above 1GHz-25GHz- Zigbee - 2480MHz

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail
3423.26	49.54	3.55	-13.73	39.36	Peak Max	V	271	303	74	-34.64	Pass
4960.72	48.25	4.25	-11.16	41.34	Peak Max	V	226	48	74	-32.66	Pass
7021.67	42	5.09	-7.8	39.29	Peak Max	V	161	159	74	-34.71	Pass
3423.26	40.42	3.55	-13.73	30.24	Average Max	H	271	303	54	-23.76	Pass
4960.72	39.12	4.25	-11.16	32.21	Average Max	V	226	48	54	-21.79	Pass
7021.67	32.06	5.09	-7.8	29.35	Average Max	H	161	159	54	-24.65	Pass

Annex A. TEST INSTRUMENT

Instrument	Model	Serial #	Cal Date	Cal Cycle	Cal Due	In use
Conducted Emissions						
R & S Receiver	ESIB 40	100179	06/08/2018	1 Year	06/08/2019	☑
CHASE LISN	MN2050B	1018	08/07/2017	1 Year	08/07/2018	☑
Radiated Emissions						
Spectrum Analyzer	N9010A	10SL0219	08/20/2017	1 Year	08/20/2018	☑
Bi-Log antenna (30MHz~2GHz)	JB1	A030702	08/12/2017	1 Year	08/12/2018	☑
Horn Antenna (1GHz~26GHz)	3115	100059	08/25/2017	1 Year	08/25/2018	☑
Horn Antenna (26GHz~40GHz)	AH-840	101013	08/28/2017	1 Year	08/28/2018	☑
Pre-Amp (30MHz~40GHz)	LPA-6-30	11140711	02/10/2018	1 Year	02/10/2019	☑
RF Conducted Measurement						
Spectrum Analyzer	N9010A	10SL0219	08/20/2017	1 Year	08/20/2018	☑

Annex B. SIEMIC Accreditation

Accreditations	Document	Scope / Remark
ISO 17025 (A2LA)		Please see the documents for the detailed scope
ISO Guide 65 (A2LA)		Please see the documents for the detailed scope
TCB Designation		A1, A2, A3, A4, B1, B2, B3, B4, C
FCC DoC Accreditation		FCC Declaration of Conformity Accreditation
FCC Site Registration		3 meter site
FCC Site Registration		10 meter site
IC Site Registration		3 meter site
IC Site Registration		10 meter site
EU NB		**Radio & Telecommunications Terminal Equipment:** EN45001 – EN ISO/IEC 17025
		Electromagnetic Compatibility: EN45001 – EN ISO/IEC 17025
Singapore iDA CB(Certification Body)		Phase I, Phase II
Vietnam MIC CAB Accreditation		Please see the document for the detailed scope
Hong Kong OFCA		**(Phase II)** OFCA Foreign Certification Body for Radio and Telecom
		(Phase I) Conformity Assessment Body for Radio and Telecom
Industry Canada CAB		**Radio:** Scope A – All Radio Standard Specification in Category I
		Telecom: CS-03 Part I, II, V, VI, VII, VIII

Japan Recognized Certification Body Designation		**Radio**: A1. Terminal equipment for purpose of calling **Telecom**: B1. Specified radio equipment specified in Article 38-2, Paragraph 1, Item 1 of the Radio Law
Korea CAB Accreditation		**EMI:** KCC Notice 2008-39, RRL Notice 2008-3: CA Procedures for EMI KN22: Test Method for EMI **EMS:** KCC Notice 2008-38, RRL Notice 2008-4: CA Procedures for EMS KN24, KN61000-4-2, -4-3, -4-4, -4-5, -4-6, -4-8, -4-11: Test Method for EMS
		Radio: RRL Notice 2008-26, RRL Notice 2008-2, RRL Notice 2008-10, RRL Notice 2007-49, RRL Notice 2007-20, RRL Notice 2007-21, RRL Notice 2007-80, RRL Notice 2004-68
		Telecom: President Notice 20664, RRL Notice 2007-30, RRL Notice 2008-7 with attachments 1, 3, 5, 6; President Notice 20664, RRL Notice 2008-7 with attachment 4
Taiwan NCC CAB Recognition		LP0002, PSTN01, ADSL01, ID0002, IS6100, CNS14336, PLMN07, PLMN01, PLMN08
Taiwan BSMI CAB Recognition		CNS 13438
Japan VCCI		R-3083: Radiation 3 meter site C-3421: Main Ports Conducted Interference Measurement T-1597: Telecommunication Ports Conducted Interference Measurement
Australia CAB Recognition		**EMC:** AS/NZS CISPR 11, AS/NZS CISPR 14.1, AS/NZS CISPR22, AS/NZS 61000.6.3, AS/NZS 61000.6.4
		Radio communications: AS/NZS 4281, AS/NZS 4268, AS/NZS 4280.1, AS/NZS 4280.2, AS/NZS 4295, AS/NZS 4582, AS/NZS 4583, AS/NZS 4769.1, AS/NZS 4769.2, AS/NZS 4770, AS/NZS 4771
		Telecommunications: AS/ACIF S002:05, AS/ACIF S003:06, AS/ACIF S004:06 AS/ACIF S006:01, AS/ACIF S016:01, AS/ACIF S031:01, AS/ACIF S038:01, AS/ACIF S040:01, AS/ACIF S041:05, AS/ACIF S043.2:06, AS/ACIF S60950.1
Australia NATA Recognition		AS/ACIF S002, AS/ACIF S003, AS/ACIF S004, AS/ACIF S006, AS/ACIF S016,AS/ACIF S031, AS/ACIF S038, AS/ACIF S040, AS/ACIF S041, AS/ACIF S043.2